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MonitoringResources.org: A suite of online tools to document monitoring protocols, methods, and designs to promote data sharing and preservation

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Summary

The Pacific Northwest Aquatic Monitoring Partnership (PNAMP) facilitates collaboration and coordination of diverse monitoring programs within the region. To aid partners, PNAMP developed a suite of integrated web tools, MonitoringResources.org, that supports practitioners to document how, when, where, and why data are collected. With standardized documentation of metadata, practitioners can document details once, easily update annually, and share their work many times. The tools help foster partnerships and promote greater understanding of the monitoring programs in a region. Monitoring Resources uses standardized documentation for data collection and analysis methods, for protocols, and for spatial and temporal study designs. Information is integrated so that users can plan more efficiently. Long term storage of information preserves annual documentation, facilitating discovery of past data collection procedures, and assisting analysts how to best synthesize and analyze data in the future. Standardized documentation supports information sharing among monitoring programs, allowing us to leverage funding for data collection and sharing. PNAMP is working with partners and subject matter experts to expand MonitoringResources.org to support continental scale monitoring of subjects in addition to aquatic monitoring.

Background

Federal, state, tribal, local, and private aquatic monitoring programs in the Pacific Northwest evolved independently in response to different organizational and jurisdictional mandates and needs. To enhance efficiency and effectiveness of their monitoring efforts, the Pacific Northwest Aquatic Monitoring Partnership (PNAMP) was established in 2003 to support collaboration and coordination among organizations and across jurisdictions. PNAMP supports organizations' monitoring objectives and facilitates integration of monitoring results, largely by focusing on best practices for data management and exchange. To fulfill those goals, PNAMP developed a network of online resources, information and tools. MonitoringResources.org helps monitoring practitioners plan and implement effective, efficient, high quality monitoring projects, and aids in coordination and integration of monitoring efforts. The tools provide guidance to design and document a monitoring project from the design stage through project implementation to generation of descriptive statistics. Practitioners can easily document their projects and programs and share them online.

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Resource managers, funders, and policy makers benefit from a comprehensive view of existing and proposed monitoring projects, allowing them to better understand how priorities are being met and where gaps or redundancies exist among monitoring programs.

PNAMP's Tools Support Project Documentation and Data Sharing

MonitoringResources.org, the framework that provides central user and organizational management, houses application tools, including Protocol and Method documentation tools, the Sample Location Designer, a Site Manager, an online Map Viewer (Monitoring Explorer), and the Metadata Builder. These tools are integrated to streamline project documentation, and can be used individually. This integration facilitates data discovery of components of a project after initial documentation.

Protocol and Method Documentation

PNAMP's protocol and method documentation tools are a public online resource. They were assembled based on the definition of a protocol as a detailed plan that explains how data are to be collected, managed, analyzed, and reported (Oakley et al. 2003). The tool guides the user through documenting a protocol specific to the organization and includes an Abstract, Objective, Study Design, Methods, Metrics and Indicators. A method is the systematic, standard operating procedure for collecting data (Measurements) or analyzing data (deriving Metrics from Measurements). MonitoringResources.org's method library has over 900 methods and we encourage users to use existing methods to promote coordination and collaboration. Documented protocols in MonitoringResources.org creates efficiencies and provides pathways for protocol metadata to link to other data management systems via web services, such as to data repositories or to real-time feeds from field data.

Site Manager and Sample Designer

The Site Manager and Sample Location Designer tools work together to help users document and share study locations, associated metadata, and their study design. Site Manager contains a complete census of sample sites defined as Master Samples, from which a sub-sample can be selected (Douge et al. 2006, Larson et al. in press). Users can learn about master sample sites, including map boundaries, attributes, and design documentation; investigate historical sites sampled by others; and upload their shapefiles of sample sites. Existing master sample files have associated attributes, shapefiles, and metadata that users can download. Data from Site Manager can be imported into the Sample Designer.

The Sample Designer assists users as they document site selection and their spatial and temporal design, resulting in a detailed record with a unique objective identifier that can be shared by sharing a URL or using web services. Specifically, using a Master Sample stored in the Site Manager tool, Sample Designer guides users to develop statistically robust generalized randomized tessellation stratification (GRTS) designs (Stevens and Olsen, 2004). The tool supports the user through the process of stratifying the sample based on the attributes (i.e. eco-region, state, county, elevation) associated with the master sample and facilitates the building of a rotating panel design. With Sample Designer, users produce consistent documentation, maps of sampling locations, and shapefiles of sample sites that can be downloaded to implement sample designs.

Monitoring Explorer

Post implementation of field sampling, Monitoring Explorer aids data discovery as a tool that can display data collection events (DCE). PNAMP and partners in the region developed Monitoring Metadata Exchange - an xml-based data exchange standard - that can be used to import data from individual monitoring programs into the Monitoring Explorer map viewer. Monitoring Explorer contains map layers, including regional GIS layers such as locations of fish trend data, and provides queries based on locations, survey types, and organizations. We are working with partners to develop data exchange standards for metric level monitoring data. Simultaneously displaying multiple programs' DCE information and detailed metadata in one centralized map viewer will greatly facilitate data discovery and coordination and collaboration of data collection and analysis.

The Metadata Builder

Metadata Builder is a prototype that facilitates the development of metadata in Monitoring Resources. Project level metadata elements are automatically collected from various project tracking systems in the region, including web resources such as MonitoringResources.org, and integrated into one ISO-compliant record using the North American Profile of ISO19115:2003 Geographic Information – Metadata standard. Metadata Builder maximizes efficiencies by collecting elements that exist online and then guiding users through documenting the missing elements. The tools will streamline the creation of metadata and could support the upcoming open data standards. PNAMP is currently seeking partners to support the further development of this tool.

User Groups

MonitoringResources.org provides a variety of resources to multiple user groups in addition to practitioners, including researchers, data managers, analysts, stakeholders, and decision makers. The MonitoringResources.org suite increases interoperability of monitoring datasets with its database of standardized metadata. Project and data managers can investigate who is collecting a specific type of data and their project locations. They can generate a list of practitioners who are calculating the same metrics and see what methods they are applying, resulting in increased collaborative efforts.

Future Directions: Expanding the Scope of Monitoring Resources

Large landscape scale issues, such as effects of climate change on sensitive ecosystems, will require unprecedented collaborative efforts among entities and their disparate datasets. The MonitoringResources.org tools are designed to address those efforts by easily documenting who is doing what, when where and how. Yet, the tools are designed to supplement other web resources such as data repositories, enterprise data systems, and data documentation tools, rather than stand alone. Further, the need for these tools ranges beyond the Pacific Northwest and aquatic monitoring. To meet these needs, PNAMP is working to expand the scope of MonitoringResources.org. We have developed web services to link MonitoringResources.org to other data systems and we are working with USGS to link various data systems. PNAMP is facilitating discussions with subject matter experts to plan how to scale MonitoringResources.org tools to beyond the Pacific Northwest and to address other areas of interest. We invite your feedback and ideas on ways to expand the scope of MonitoringResources.org.

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Competing Interests

The authors declare that they have no competing interests.

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